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# SARDIS: TWENTY-SEVEN YEARS OF DISCOVERY

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## METALWORK AND METALWORKING AT SARDIS

Jane C. Waldbaum

The expression "rich as Croesus" is a familiar one. It has come to denote someone who enjoys the pleasures of limitless wealth and the power that often accompanies it. Few realize, however, that this expression is rooted in historical fact; that Croesus was a real king whose very real riches were based on an abundance of natural resources, particularly gold, with which his kingdom of Lydia and its capital Sardis were blessed.

Croesus of course is long gone, and his wealth has long since been dispersed, but the legends that have grown up around him since antiquity have attracted the interest of many to his capital—from treasure hunters in all ages to modern archaeologists who have ultimately explored many more aspects of the art and culture of ancient Sardis than simply the gold of Croesus. Nevertheless, the gold remains a lure, and beyond that, the metal industry and metal products of Sardis were in several periods of her history a source of prosperity and prestige, and therefore are worthy of our attention.

Over 1,000 metal objects found at Sardis have already been described in previous publications (Waldbaum 1983). These objects come from all phases of Sardis' history—Bronze Age, Lydian, Persian, Hellenistic, Roman, Byzantine, and Turkish—and include examples of all the metals known to have been utilized in antiquity: iron, copper and its alloys bronze and brass, silver, lead, and of course gold. These metals were used for a variety of purposes at ancient Sardis, just as they are now. Bronze, brass, and iron were used to make utilitarian objects of all kinds—tools and utensils for domestic and agricultural purposes, carpentry and masonry tools, nails and clamps, weapons and armor

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for the many battles fought in the history of Sardis, and shopkeepers' stock-in-trade: hardware, locks and keys, pots and pans. Gold, silver, and fine bronze were also used for more decorative and luxurious purposes—statues and statuettes, jewelry, mirrors, and cosmetic implements for the boudoirs of the ladies of Sardis, as well as for vessels and ornaments to be buried with the dead or dedicated to the gods, and for the liturgical equipment of the local pagan, Christian, and Jewish clergy. In addition, a number of finds in other materials such as stone molds and clay tuyères, or bellows nozzles, attest to the manufacture of metal objects in certain periods.

The study of the metalwork and metal industries at Sardis has taken many forms. Stylistic and typological study of the archaeological finds themselves has been combined with study of ancient literary sources, inscriptions, scientific analyses and investigations of the materials and workshops where metalworking was carried on. The analytical program was instituted in order to supplement information on the shape, function, and date of particular pieces with insight into how they were made and what their major alloying ingredients were. The information thus gathered is the result of collaboration among many specialists—archaeologists, epigraphers, geologists, metallurgists, analytical chemists, conservators, and others—all of whose determinations have been brought together to help form the picture of the use and importance of metals at Sardis through the ages.

Gold was the most famous of Sardis' mineral resources. Ancient authors tell us that the chief source was the alluvial gold washed down from Mount Tmolus by the Pactolus stream. According to Strabo (13.1.23; 13.4.5) native gold had been exploited at least from the time of Gyges in the 7th century B.C. through the time of Croesus in the mid-6th. But by Strabo's own time, toward the end of the 1st century B.C., the gold in the Pactolus had apparently been exhausted. Although the gold industry in the Lydian era is thus documented, it is not known exactly how long the gold supply lasted.

After the Persian conquest in 547 B.C. Sardis became a tributary of the Persian empire. A Persian source of the 5th century B.C. reports that Sardian gold was among the tribute brought to the capital at Susa, where it was worked by Median and Egyptian craftsmen. This tribute implies that Lydian gold sources were still productive at least through the end of the 6th century and possibly into the 5th. Hellenistic inscriptions from Sardis testify to rather lavish use of gold to ornament bronze portrait statues, a practice which the late George Hanfmann suggested might indicate the continued local production of gold (Waldbaum 1983).

The Lydians were noted for wealth in silver as well as gold, and as A. Ramage has already pointed out, the Pactolus gold was actually a natural electrum with a high silver content. Silver could be separated from the gold by



the practice of cementation, described herein by A. Ramage. Other sources of silver, including silver-rich lead deposits, have been identified within easy range of Sardis.

The sources of the other metals used at Sardis—copper, iron, tin, zinc, and lead—have not yet been precisely identified, though most, with the exception of tin, were probably to be found in ore deposits that were fairly accessible to Sardis.

The history of metal production at Sardis begins in the Early Bronze Age with several objects found in or near the tombs at the Gygean Lake (see Mitten, herein, Fig. 4). Although the number of finds was not great, they already show use of at least three different metals (gold, silver, and copper) and a variety of functions—two decorative earplugs (Mitten, Fig. 5), three small copper daggers, three copper or copper alloy straight pins, a silver pendant in the shape of a ram, and three silver finials. The earplugs have been analyzed by neutron activation and shown to be made of gold with a silver content ranging from about 6 to 15 percent in different parts of the pieces. The varying composition is curious, since it has been assumed that each was made of a single piece of sheet metal. The high silver content, however, suggests that the Early Bronze Age inhabitants were already exploiting the natural electrum of the Pactolus. One of the daggers was also analyzed by optical emission spectrography and found to be made of a nearly pure copper rather than alloyed with tin to form bronze, while two of the pins proved to be alloyed with small amounts of arsenic. Recent analytical research on material from all over the Mediterranean shows that the use of pure copper or of copper alloyed with arsenic rather than tin is in fact the norm for this period.

Metal finds of the Middle and Late Bronze Age are exceedingly rare, and the next era for which we have clear evidence is the Lydian. Herodotus, the 5th century B.C. Greek historian, provides several anecdotes recounting the vast wealth dedicated by the Lydian kings to the sanctuary of Apollo at Delphi. Gyges, the first king of the Mermnad dynasty, who lived in the first half of the 7th century B.C., is reported to have dedicated several offerings of gold and silver (Herodotus I.14) including six golden bowls weighing a total of 30 talents (one talent weighs between 60 and 80 pounds). Alyattes, who reigned in the early 6th century B.C. also gave gifts to Delphi, including a silver vessel on a welded iron stand crafted by an East Greek artist, Glaukos of Chios (Herodotus I.25). The iron stand apparently remained in place long after the gold and silver had been removed and itself attracted the attention of later writers for the uniqueness of its craftsmanship.

Croesus, Alyattes' successor, gave even more. In addition to the famous lion monument described by A. Ramage herein, his gifts to Delphi included two large bowls—one of gold, one of silver. The gold bowl weighed over eight talents,

and the silver had a capacity of over 5,000 gallons and was crafted by Theodoros of Samos, one of the most famous East Greek sculptors and metalsmiths of the Archaic era. (The employment of Glaukos of Chios by Alyattes and Theodoros of Samos by Croesus suggests the high value placed on Greek artisanry by the non-Greek Lydian kings.) Croesus also gave to Delphi a life-sized gold statue of a woman (honoring his baker who saved him from being poisoned) and numerous smaller objects of precious metals which Herodotus does not bother to describe in detail (Herodotus I.50, 51). In addition to what he lavished on Delphi, Croesus hedged his bets by dedicating valuables at other Greek shrines as well. He is said to have exactly duplicated his gifts to Delphi at the Milesian sanctuary of Didyma in western Turkey and to have donated golden bulls, sculpted column bases, and other rich offerings at the sanctuary of Artemis at Ephesus, which was closely linked to the cult of Artemis at Sardis itself (Herodotus I.92).

Needless to say, very little of this conspicuous wealth remains today. While many of the gifts of Croesus and his ancestors to Delphi were apparently still in place in Herodotus' time, nearly 100 years after the time of Croesus, practically none was to be seen there when the traveler Pausanias made his visit in the 2nd century A.D. By then, most had already been melted down or carried off. Sardis herself had been subject to continuous plundering, looting and grave robbing since at least the time of the Persian conquest, leaving only pitifully few Lydian objects in gold or silver and not much more in other metals to be found by the current expedition.

All traces of monumental sculpture and vessels in precious or other metals have vanished. Most of the evidence for metalworking in this period consists of small-scale objects, supplemented by the very important find of the gold refinery described by A. Ramage herein. One tantalizing small survivor of the age of Lydian glory is a tiny melon-shaped gold bead, now in the regional museum at Manisa, the segments of which are separated by rows of delicate granulation (Fig. 19). The bead owes its survival to its deposition in the protected environment of a grave dated to the second quarter of the 6th century B.C. In the same tomb was a small piece of gold wire attached to an agate bead. Both were analyzed by neutron activation and proved to be gold of a high degree of purity, possibly products of the refining activities which were being carried on contemporaneously. (It is interesting to note, in this regard, that the contemporary lamb earring, described by N. Ramage herein and shown in Fig. 19, contained a very high proportion of silver—over 30 percent—showing that it had been made of unrefined, or even diluted, electrum.) These were among the very few preserved objects in gold from all of Lydian Sardis.

Two examples of small-scale decorative relief sculpture from the 6th century B.C. are of bronze. They are flat plaques, one in the shape of a reclining boar, the other, a smaller one in the form of a recumbent ibex with head turned

back over his rump. Judging from the attachment loops on the backs, these were probably used as horse trappings. (Boar: Fig. 21; N. Ramage herein; ibex: Fig. 22) The interesting thing about the ibex is that it is unfinished; the edges are unsmoothed and the surface lacks the sharp detail of a finished product. This almost surely indicates that the piece was being manufactured in Sardis and was discarded for some reason, perhaps because of casting flaws, before completion. Unfortunately, the context in which it was found does not shed any light on possible workshop practices, but the piece does provide valuable evidence for a local Sardian school of decorative bronzework that should probably include the boar as well. Parallels in ivory for both boar and ibex have been found in the sanctuary of Artemis at Ephesus, where we know the Lydian kings made gifts. Several close relatives to the ibex in bronze are also extant in a number of museum collections, though only the Sardis piece comes from an excavated context (Waldbaum 1983a).

Sardis was conquered by the Persians in 547 B.C., and traces of the battle have been preserved in the form of arrowheads of Persian types found on the acropolis and in the lower town (Fig. 11). Several of these have been analyzed by optical emission spectrography and/or atomic absorption, and most were shown to be tin bronzes to which lead had been added, presumably to increase the fluidity of the melted bronze during casting. Since arrowheads were more or less mass produced, and were intended to be expendable, perhaps the lead was also used to reduce the amounts of more expensive tin and copper in the alloy, and thereby cheapen the products. Similar types of arrowheads are known from many other sites in Anatolia and Greece, which came into conflict with the Persians in the 6th and 5th centuries B.C. Over 3,600 examples of a three-edged, socketed variety of arrowhead were found at the Persian capital of Persepolis itself. Although most of the Sardis arrowheads came from contexts that were not stratigraphically revealing, they and the parallels from Persepolis and elsewhere help to dramatize the violent events of 547 B.C. that caused the downfall of the wealthy Lydian kingdom (Waldbaum 1983).

Despite Sardis' position as a major Persian, Hellenistic, and Roman city, we know little of her metal industry for some centuries after the fall of the Lydians. Stratification of the later periods at the site is disrupted, and we have not chanced on much other than sporadic finds from these centuries. An area of industrial debris in a Hellenistic level of the House of Bronzes sector (Fig. 7, No. 4) may shed some light on bronze production in that era. According to an unpublished report by the late G. F. Swift, Jr., the industrial deposits here extended over an area some 8 to 10 meters in diameter and about 50 centimeters thick. They contained fragments of the clay floor of a furnace, pieces of clay molds, earth discolored by heat, fragments of charcoal and corroded copper and/or bronze, slag pieces, and quantities of animal bone (possibly to make bone ash for flux). All of this material perhaps suggests the presence of a bronze

foundry. The full significance of this area and its associated finds has not yet been studied, nor has the exact type of industrial activity carried on there been determined. Large quantities of the materials from this industrial area have been stored in the laboratory at Sardis and await future scientific investigation.

The next era for which the evidence is more complete is the late Roman/early Byzantine, ca. 3rd through early 7th centuries A.D. Here we find a very different situation from that in the Lydian era. It appears, indeed, that in the late Roman/early Byzantine era the foundation of the metal industry at Sardis was not gold, but iron and copper and the copper alloys bronze and brass, and that the objects for which Sardis was known at that time were not luxury items but functional and utilitarian products.

According to what we know from ancient sources, the Roman imperial metal industry in general was subject to a high degree of specialization. Different towns throughout the Roman Empire manufactured goods of special quality or distinctive types which were then dispersed by trade to other areas of the empire. One town near Sardis, for example, is known to have specialized in producing nails, another bed frames, and a third building materials, while Sardis herself was famous for production of iron-cutting tools—knives, rasps, swords and engraving tools (all of which presuppose the working of hardened steel to suit their special functions).

The peak of the Sardian iron industry came in late Roman times (3rd–4th centuries A.D.) when Sardis was the seat of an imperial weapons and shield factory or *fabrica*. Such factories, instituted under Diocletian, were very large and employed big work forces. They were operated by the state and were supplied with raw materials such as iron and charcoal by the state. Workers were ranked as soldiers and tied to their occupations by heredity. Such an institution would clearly have had an important effect on the social, economic, and political life of the community in which it operated. Since the factory at Sardis was one of only three such establishments in Asia Minor, it must have represented a substantial undertaking (Foss 1976).

The factory buildings at Sardis have not been located or excavated, and surprisingly few weapons attributable to the late Roman period have been found on the site. Clive Foss suggests unexcavated Building A (Fig. 7, No. 24)—a large 3rd to 4th century A.D. building in the center of town—as a possible location for the factory (Foss 1976), but there is no evidence to support this identification. In fact, the central location of Building A among the public structures of Sardis argues more strongly against its housing a large, noisy, and smelly industrial establishment. In 1979 a detailed surface survey located an area of industrial activity with a heavy concentration of slag and late Roman coarse pottery on the surface of the ground near the northeast edge of the late antique city wall (Fig. 7, No. 9.15). This area may have some relation to the *fabrica*, which further



exploration would reveal. A few objects from the same period have been tentatively identified as smith's tools (Waldbaum 1983, nos. 143-148), although none can be associated specifically with the *fabrica*. Several inscriptions, however, confirm the existence of the *fabrica*.

The most interesting of these inscriptions were discovered in 1976. They are painted inside the 4th century A.D. tomb of a well-to-do man announcing the dedication of the tomb to its owner, "Flavios Chrysanthios, *ducenarius* and worker in the arms factory." Another inscription in the same tomb says that the owner was both *ducenarius* (apparently his official title) and painter of images (*zoographos*), and furnished or decorated his own tomb (Greenewalt 1978; see N. Ramage herein for description of the tomb). The term *ducenarius* here is interpreted by epigraphers as connoting a high-salaried official who may have been director of the arms factory (though there is some question about this). His amateur interest in painting is unusual for someone of his presumed social rank, and this discovery may give us evidence for one of the first "Sunday painters" in history.

The arms factory was a major industry, turning out weapons for the troops of Rome. Manufacture of items for local consumption took place on a smaller and more local scale. And for this we have considerable evidence both for the products and for their production.

The great bulk of the metal objects that we have found date to the early Byzantine era (6th to early 7th centuries A.D.) and come from two areas located fairly close together at the site. These were the "House of Bronzes" on the south side of the modern (and ancient) highway (Fig. 7, No. 4) and the Byzantine shops on the north side of the highway, just across the road from the house (Fig. 7, No. 3). Judging from the many liturgical objects with Christian symbolism on them found in the house, it probably belonged to a Christian cleric (some have suggested the Bishop of Sardis) of the late 6th to early 7th centuries A.D. The metal objects from the House of Bronzes were all found together on the floors of a basement storeroom, where they had been left when the house was burned and abandoned. The Byzantine shops form a kind of shopping center near the main part of town. They are arranged in two long rows of some 25 to 30 small shops set on either side of the main colonnaded street through town. One row, backing onto the great late Roman gymnasium and synagogue, has been excavated. The shops and the House of Bronzes were destroyed simultaneously in the early 7th century A.D. by an invasion of Sassanian Persians, leaving many of their contents intact and *in situ* and providing us with a great deal of valuable, well-dated information.

The shops themselves were small and narrow, one- or two-room cubicles with their wares stacked both inside and outside on the sidewalk within the colonnade. One can picture them when busy as closely resembling a modern

Middle Eastern bazaar. Objects found in the shops probably constituted most of the individual owners' stock-in-trade, together with equipment such as steelyards and balances for weighing out goods. Various household items such as copper pots, pans, jugs, and bowls were probably made or finished on the spot and then piled on the floor and outside the door to attract customers, again anticipating modern practice.

One of the shops has been nicknamed by the excavators "the hardware shop" because it contained quantities of tools, utensils, and odds and ends of the types that would be sold in any hardware shop from then to now. Like many hardware dealers, the shop owner was also a locksmith, for among his wares were nearly 200 bronze and iron locks in various shapes and sizes — some not yet finished, but either in process of manufacture or repair (Fig. 52). Most of the locks were heavily corroded, but some had their mechanisms at least partly preserved, giving us some clue to the action of these locks. Most were made of a front and back plate with a keyhole on each side and the bolts and springs sandwiched in between. Keys were also found, though curiously most of the keys recovered were not of a type that would correspond to the majority of lock types found. Most of the keys were small and probably fitted the locks of small ornamental caskets or boxes. They were frequently attached to rings that could be worn on the finger to prevent loss (rather like wearing mittens on a string around the neck).

Found in both the House of Bronzes and the Byzantine shops were a number of fine copper alloy vessels and Christian liturgical objects. The forms of those found in the house and the shops were similar, suggesting that the objects were made in the shops on one side of the road and put to use in the cleric's house on the other. Several incense burners or censers, for example, were found in both shops and house; some were round, some hexagonal, and some hemispherical, all with three little feet and three hanging chains attached to the rims (Fig. 54). In Byzantine ritual these censers would have been filled with glowing coals of incense and swung by the priest, who carried them in procession.

A related object from the House of Bronzes storeroom, and now in the Manisa Museum, is a fine incense shovel for lifting hot coals of incense. It has a flat, square scoop, a heavy four-armed cross at the back surmounted by an arch, and two stylized dolphins with lifted tails forming decorative side pieces. The surface of the cross is decorated with incised circles, and the markings on the dolphins are also incised. At the back is a hollow socket into which could be fitted a wooden handle for carrying it about (Fig. 55). Numerous parallels can be found elsewhere in the eastern Early Christian/Byzantine world.

The most interesting of the secular objects from the late Roman/early Byzantine period are the 29 buckles that were found. Eleven came from the

Byzantine shops, and the rest were scattered among such locations as the acropolis, the gymnasium complex, the synagogue, Pactolus North, and elsewhere (Waldbaum 1983). The buckles show a wide variety of forms (Fig. 53), but most can be shown to belong to groups of closely related types distributed widely throughout Europe and the Near East, and generally dated to the 6th and early 7th centuries (Fig. 53, left). Since many have been found in barbarian graves belonging to Bulgars, Avars, Lombards, and the like in Hungary, South Russia, Albania, Greece, Romania, and Italy, some scholars believe they were made by the barbarians themselves. Others suggest that they were made in a single center, such as Constantinople, and sold to the barbarian "market." Whatever the case, these objects were almost certainly imported into Sardis and may attest to the presence of some of those same barbarian invaders who ushered in the Dark Ages in Europe. A particularly handsome and unusual example, found in one of the Byzantine shops, is a large buckle hinged to a plate with double eagle heads at the corners (Fig. 53, center). The piece was cast and deep circles were punched on the surface, probably to hold inlays in contrasting materials such as glass or paste.

As with earlier material, scientific analyses were performed on a number of examples of Roman and early Byzantine metal objects. The results show that the alloys used were quite different from those used in earlier periods. For example, while most of the Lydian objects tested by emission spectrography or atomic absorption proved to be tin bronzes or tin bronzes to which some lead had been added, most of the early Byzantine cast copper alloys including many of the buckles and censers, as well as other objects such as lamp chains, lamp holders, and crosses, turned out to be rather curious quaternary, or four part, alloys containing not only tin and lead but also zinc in varying proportions. Hammered sheet metal objects such as vessels, on the other hand, were for the most part of nearly pure copper, while several Roman/early Byzantine cosmetic implements were true brasses, containing zinc but no significant amounts of tin or lead (Waldbaum 1983, Chap. V).

The occurrence of ternary and quaternary alloys containing various combinations of copper with zinc, tin, and lead is interesting. Quaternary alloys, equivalent to modern "gun metal," seem to have come into use in the 3rd century A.D. and remained popular thereafter, probably because of the working advantages imparted to the copper by addition of all three ingredients. The tin adds strength and hardness to the finished product, the zinc acts as a deoxidant in casting, and the lead increases fluidity of the melt in casting. Whether this practice is owing to the remelting of heterogeneous scrap metals containing these alloying ingredients or whether it is the result of deliberate alloying is unclear. At any rate, it seems that the metalworkers of these periods were able to vary their alloys to suit the kinds of artifacts they were interested in making. Pure copper, for example, is softer and therefore easier to work by hammering

than alloyed metal, whereas the casting properties of copper as well as its durability and strength are enhanced by the addition of other elements, such as tin, lead, or zinc (Waldbaum 1983, Chap. V).

With the invasion and destruction of the early 7th century, both the Byzantine shops and the House of Bronzes (and of course the rest of the early Byzantine city of Sardis and the flourishing industries it supported) fell. From that time on the city went into a long decline lasting to the present day. And the material finds of later eras never suggest a return to the earlier prosperity for which we have abundant evidence.

Though the style of material culture differed drastically throughout the millennia, the approach of modern scholars in their attempts to derive the fullest information possible from all forms of evidence is essentially the same. By combining our knowledge of ancient literary and historical sources, inscriptions, archaeological investigations in the field, and geological, chemical, metallurgical, and other kinds of scientific analyses with a thorough study of the objects recovered, from the most elegant to the most mundane, we can reconstruct much of importance in the life of the great city of ancient Sardis.

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